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(71)Applicant : SHARP CORP
(72)Inventor : KUBO MASUMI
KIJIMA RYUICHI
FUJIOKA SHIYOUGO
NARUTAKI YOZO

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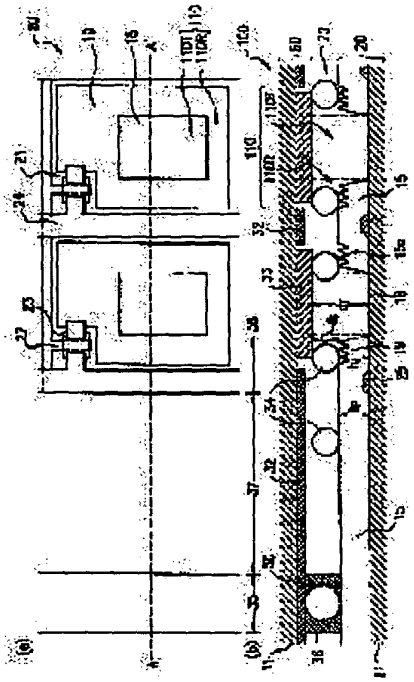
(54) LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain high display quality free from display defects by specifying the mode of the height from the substrate surface on the insulating film surface within non-display regions and the maximum height and minimum height from the substrate surface on the reflection layer surface of the ruggedness shape within display regions, so as to satisfy a specified relation.
SOLUTION: A surface 15a of an interlayer insulating film 15 of the positions where reflection electrodes 19 are formed to have the ruggedness shape. The interlayer insulating film 15 is formed not only in the reflection electrode regions 110R within the display regions 38 but in the non-display regions 37 as well. The interlayer insulating film 15 of the non-display regions 37 is so formed that a mode mode (the height from a glass substrate 11 surface where the occupying area is the largest) of the height from the glass substrate 11 surface on the surface of the non-display regions 37 and a maximum height Hmax and minimum height Hmin from the glass substrate 11 surface on the reflection electrode 19 surface of the ruggedness shape within the display regions 38 satisfy the relation $Hmin-0.5 \leq hmode \leq Hmax+0.5$ (units of μm).



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CLAIMS

[Claim(s)]
[Claim 1] The viewing area which has the liquid crystal layer pinched between the 1st and 2nd substrates, and this 1st substrate and this 2nd substrate, and has two or more picture element fields specified by the electrode of the couple which impresses voltage to this liquid crystal layer, It is the liquid crystal display which has the surrounding non-display field of this viewing area. this 1st substrate It has the reflector field prepared for two or more of these picture element fields of every in this viewing area. this reflector field It has the insulating layer which has a toothing-like front face, and the reflecting layer formed on this insulating layer. and this 1st substrate The mode hmode of the height from a substrate front face [in / the insulating-layer front face in this non-display field / it has an insulating layer also in this non-display field, and] Highest height Hmax from the substrate front face in the reflecting layer front face of the shape of toothing in this viewing area and the minimum lowness Hmin are Hmin-0.5 <=hmode<=Hmax +0.5. (unit : micrometer)
The liquid crystal display which fills ******.
[Claim 2] Highest height Hmax from the substrate front face in the reflecting layer front face of the shape of height h from the substrate front face in the insulating-layer front face in the aforementioned non-display field and toothing in the aforementioned viewing area and the minimum lowness Hmin are Hmin-0.5 <=h<=Hmax +0.5. (unit : micrometer)

The liquid crystal display according to claim 1 which fills ******.
[Claim 3] or [that the insulating layer in the aforementioned non-display field is the same as the aforementioned insulating layer in the aforementioned viewing area] -- or the liquid crystal display according to claim 1 or 2 which has the front face of the shape of different toothing
[Claim 4] The insulating layer in the aforementioned non-display field is a liquid crystal display according to claim 3 which has the front face of the shape of almost same toothing as the aforementioned insulating layer in the aforementioned viewing area.
[Claim 5] The viewing area which has the liquid crystal layer pinched between the 1st and 2nd substrates, and this 1st substrate and this 2nd substrate, and has two or more picture element fields specified by the electrode of the couple which impresses voltage to this liquid crystal layer, It is the liquid crystal display which has the surrounding non-display field of this viewing area. this 1st substrate It has the reflector field prepared for two or more of these picture element fields of every in this viewing area. this reflector field It has the insulating layer which has a toothing-like front face, and the reflecting layer formed on this insulating layer. and this 1st substrate The liquid crystal display with which it has an insulating layer in this non-display field, and the interval of this 1st substrate and this 2nd substrate was prepared on the portion which is not covered by the reflecting layer of this insulating layer in this viewing area, and this insulating layer in this non-display field and which is mostly controlled by the spacer of the same particle size uniformly.
[Claim 6] The distribution of the height from the substrate front face of the aforementioned insulating layer in the aforementioned viewing area and the distribution of the height from the substrate front face of the aforementioned insulating layer in the aforementioned non-display field are the same liquid crystal display according to claim 5 substantially.
[Claim 7] Two or more source wiring arranged so that two or more gate wiring, these gate wiring of two or more, and the 1st substrate of the above may cross at right angles, Two or more switching elements formed near the intersection of these gate wiring of two or more and these source wiring of two or more, It has with two or more picture element electrodes connected to ******** of two or more of these switching elements. the 2nd substrate of the above It is the liquid crystal display as which two or more aforementioned picture element fields are specified by this liquid crystal layer that has a counterelectrode and was pinched by two or more of these picture element electrodes, this

counterelectrode, and two or more of these picture element electrodes and this counterelectrode. This 1st substrate is a liquid crystal display according to claim 1 to 6 which has further the transparency electrode field prepared for two or more of these picture element fields of every.

[Claim 8] It is the liquid crystal display according to claim 1 to 7 whose aforementioned liquid crystal layer thickness on this reflector field the 1st substrate of the above has further the transparency electrode field prepared for two or more aforementioned picture element fields of every, and is about 1 of this liquid crystal layer thickness on this transparency electrode field/2.

[Claim 9] The liquid crystal display according to claim 1 to 8 with which it has the seal section which carries out the seal of the aforementioned liquid crystal layer to a gap with this 1st substrate and this 2nd substrate to the aforementioned non-display field, and the aforementioned insulating layer is not formed in the field in this non-display field of the 1st substrate of the above corresponding to this seal section while pasting up the 1st substrate of the above, and the 2nd substrate of the above.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the liquid crystal display with which the reflected type liquid crystal display and penetrated type which are used for the camcorder/movie equipped with pocket information machines and equipment, such as OA equipment, such as a word processor and a personal computer, and an electronic notebook, or the liquid crystal display monitor etc., and a reflected type are combined.
[0002]
[Description of the Prior Art] Since a liquid crystal panel does not emit light itself unlike CRT (Braun tube) or EL (electroluminescence) display, the penetrated type liquid crystal display which displays by installing equipment equipped with the fluorescence pipe called back light back, and changing transparency and interception of the light from a back light with a liquid crystal panel is used.
[0003] However, with a penetrated type liquid crystal display, in order that a back light may usually occupy 50% or more of the total power consumption of a liquid crystal display, power consumption will become large by preparing a back light.
[0004] Therefore, in pocket information machines and equipment with many opportunities to use outdoors and always carrying, a reflecting plate is installed instead of a back light, and the reflected type liquid crystal display which displays by changing the transparency and interception of the reflected light of an ambient light by the reflecting plate with a liquid crystal panel is also used.
[0005] For example, in order that JP,5-323371,A may expand a picture element field also on wiring and may aim at improvement in a numerical aperture On the switching element connected to two or more gate wiring which intersects perpendicularly, two or more source wiring, and gate wiring and source wiring of these plurality, respectively In the liquid crystal display which prepared the layer insulation layer, and was formed so that a part of reflector field of the picture element electrode formed on the layer insulation layer, gate wiring, and source wiring might lap By preparing the irregularity of several micrometer depth in the front face of a layer insulation layer, it is indicating that the few good display of a viewing-angle dependency is obtained by forming the reflector field which has a toothing-like front face by using the ambient light of the various degrees of incident angle as a display light.
[0006]
[Problem(s) to be Solved by the Invention] However, in the conventional liquid crystal display currently indicated by the above-mentioned official report, the gap between the substrates of the couple which constitutes a liquid crystal display (the so-called cell gap) could not be controlled with a sufficient precision, but the problem that display quality deteriorated might occur.
[0007] In the conventional liquid crystal display, a granular spacer is arranged to the substrate (for example, an active-matrix substrate and an opposite substrate) of the couple whose liquid crystal layer is pinched, and the method of controlling a cell gap is used for it. Generally the method of controlling the gap between the substrates of a couple is used by specifically sticking on one [at least] substrate using a sealing compound, pressurizing the substrate of a couple through a granular spacer, after sprinkling uniformly a granular spacer (for example, spherical spacer made of a plastics resin). The size of the spacer which determines a cell gap is determined according to liquid crystal display mode. Usually, the spherical spacer (or pillar-like spacer) whose diameter is about 2-6 micrometers is used as a size which obtains the cell gap of the optimal optical path length. By this method, when irregular [if a granular spacer is sprinkled, it is difficult for the specific position on a substrate to arrange a spacer, and] (level difference) on the surface of the substrate, there was a case where a uniform cell gap was not obtained.
[0008] A positive-type photopolymer is applied on a substrate, using a spin coater etc. as a method of forming the shape of toothing in the front face of an above-mentioned layer insulation layer, it exposes through the mask which has

the pattern of a desired configuration to a reflector field, and there is the method of forming by [which developed negatives] carrying out a postheat treatment (refer to drawing 6). When the layer insulation layer which has the shape of toothing was formed only in a reflector field only paying attention to improvement in reflected light use efficiency, the invention-in-this-application person found out producing the following troubles.

[0009] This problem is explained referring to drawing 17 . In case the ground layer for forming the shape of toothing is formed in the front face of a layer insulation layer using a positive-type photopolymer, when the ground layer of a non-display field is made unexposed, a poor display may occur near the non-display field in a viewing area (hatching section in the viewing area in drawing 17 (a)).

[0010] As for this, the ground layer of the unexposed portion of a non-display field becomes thicker than the ground layer which has the heights by which the viewing area was exposed. This is because film decrease takes place by exposing and developing a positive resist. Therefore, if the spacer of the same particle size is sprinkled, between a viewing area and a non-display field, a cell gap will change and the part which has a bigger cell gap than a predetermined cell gap in a viewing area especially will be made. A poor display occurs by the variation in this cell gap.

[0011] In the reflective transparency two-ways type liquid crystal display currently especially indicated by Japanese Patent Application No. No. 201176 [nine to] by the applicant for this patent, as for the invention-in-this-application person, deterioration of the display quality by the variation in a cell gap found out that a twist was also large in the reflected type liquid crystal display. In order to raise the display quality of a reflective transparency two-ways type liquid crystal display, it is desirable to make the optical path length in a reflective field and a transparency field in agreement as much as possible. That is, it is desirable to set the liquid crystal layer thickness of a reflective field as 1/2 of the liquid crystal layer thickness of a transparency field. For example, if a cell gap shifts from an optimum value Xmum, to the optical path length of a transparency field shifting from an optimum value Xmum, the optical path length of a reflective field will shift from an optimum value 2 Xmum, and it originates in the grades of the influence which a gap of a cell gap has on a display differing in a transparency field and a reflective field.

[0012] The variation in a cell gap brings about deterioration of display quality also in which liquid crystal display modes, such as TN (Twisted Nematic) mode, parallel orientation mode, and perpendicular orientation mode. When a normally white mode is especially adopted as a display mode, the fall of the contrast ratio by change of a cell gap is large. In a normally white mode, since a black display is performed where predetermined voltage is impressed, the voltage value which should be impressed for a barrack and a black display of a cell gap will change with places, and the quality of a black display deteriorates. Since the quality of a black display state influences greatly rather than a white display state, in a normally white mode, the fall of a contrast ratio becomes large at a contrast ratio.

[0013] this invention is made in order to solve the above-mentioned technical problem, and it aims at offering the high reflected type of the display quality with the poor display by the variation in a cell gap which is not, or a reflective transparency two-ways type liquid crystal display.

[0014]

[Means for Solving the Problem] The viewing area which the liquid crystal display of this invention has the liquid crystal layer pinched between the 1st and 2nd substrates, and this 1st substrate and this 2nd substrate, and has two or more picture element fields specified by the electrode of the couple which impresses voltage to this liquid crystal layer, It is the liquid crystal display which has the surrounding non-display field of this viewing area. this 1st substrate It has the reflector field prepared for two or more of these picture element fields of every in this viewing area. this reflector field It has the insulating layer which has a toothing-like front face, and the reflecting layer formed on this insulating layer. and this 1st substrate The mode hmode of the height from a substrate front face [in / the insulating-layer front face in this non-display field / it has an insulating layer also in this non-display field, and] Highest height Hmax from the substrate front face in the reflecting layer front face of the shape of toothing in this viewing area and the minimum lowness Hmin are Hmin-0.5 <=hmode<=Hmax +0.5. (unit : micrometer)

****** is filled and the above-mentioned purpose is attained by that.

[0015] Highest height Hmax from the substrate front face in the reflecting layer front face of the shape of height h from the substrate front face in the insulating-layer front face in the aforementioned non-display field and toothing in the aforementioned viewing area and the minimum lowness Hmin are Hmin-0.5 <=h<=Hmax +0.5. (unit : micrometer)
It is desirable to fill ******.

[0016] or [that the insulating layer in the aforementioned non-display field is the same as the aforementioned insulating layer in the aforementioned viewing area] -- or it is desirable to have the front face of the shape of different toothing

[0017] As for the insulating layer in the aforementioned non-display field, it is desirable to have the front face of the shape of almost same toothing as the aforementioned insulating layer in the aforementioned viewing area.

[0018] The viewing area which the liquid crystal display of this invention has the liquid crystal layer pinched between the 1st and 2nd substrates, and this 1st substrate and this 2nd substrate, and has two or more picture element fields specified by the electrode of the couple which impresses voltage to this liquid crystal layer, It is the liquid crystal display which has the surrounding non-display field of this viewing area. this 1st substrate It has the reflector field prepared for two or more of these picture element fields of every in this viewing area. this reflector field It has the insulating layer which has a toothing-like front face, and the reflecting layer formed on this insulating layer. and this 1st substrate Have an insulating layer in this non-display field, and the interval of this 1st substrate and this 2nd substrate with the spacer of the simultaneously same particle size prepared on the portion which is not covered by the reflecting layer of this insulating layer in this viewing area, and this insulating layer in this non-display field It is controlled uniformly and the above-mentioned purpose is attained by that.
[0019] It is desirable that the distribution of the height from the substrate front face of the aforementioned insulating layer in the aforementioned viewing area and the distribution of the height from the substrate front face of the aforementioned insulating layer in the aforementioned non-display field are substantially the same.
[0020] Two or more source wiring arranged so that two or more gate wiring, these gate wiring of two or more, and the 1st substrate of the above may cross at right angles, Two or more switching elements formed near the intersection of these gate wiring of two or more and these source wiring of two or more, It has with two or more picture element electrodes connected to ******** of two or more of these switching elements. the 2nd substrate of the above It is the liquid crystal display as which two or more aforementioned picture element fields are specified by this liquid crystal layer that has a counterelectrode and was pinched by two or more of these picture element electrodes, this counterelectrode, and two or more of these picture element electrodes and this counterelectrode. This 1st substrate is good also as composition which has further the transparency electrode field prepared for two or more of these picture element fields of every.
[0021] The 1st substrate of the above has further the transparency electrode field prepared for two or more aforementioned picture element fields of every, and, as for the aforementioned liquid crystal layer thickness on this reflector field, it is desirable that it is about 1 of this liquid crystal layer thickness on this transparency electrode field/2.

[0022] While pasting up the 1st substrate of the above, and the 2nd substrate of the above, it is desirable to consider as the composition in which it has the seal section which carries out the seal of the aforementioned liquid crystal layer to a gap with this 1st substrate and this 2nd substrate to the aforementioned non-display field, and the aforementioned insulating layer is not formed in the field in this non-display field of the 1st substrate of the above corresponding to this seal section.
[0023] Hereafter, an operation of this invention is explained.
[0024] In a liquid crystal display, when the height from a substrate front face [in / the insulating-layer front face of a non-display field / when the insulating layer which has a concavo-convex front face in a viewing area exists] differs from the height from the substrate front face in the reflecting layer front face of the shape of toothing in the viewing area in a viewing area remarkably, in a viewing area and a non-display field, the difference of the interaction of the front face and spacer which support a spacer becomes large, and uniform cell ** is not obtained over the whole panel. Then, highest height Hmax from the substrate front face in the reflecting layer front face of the shape of toothing in the mode (the area occupied most is the height from a latus substrate front face) hmode of the height from the substrate front face in the insulating-layer front face in a non-display field if it is in this invention, and a viewing area, and the minimum lowness Hmin are Hmin-0.5 <=hmode<=Hmax +0.5. (unit : micrometer)
It is possible by forming the insulating layer of a non-display field to carry out the display unevenness resulting from cell thick unevenness into tolerance so that ****** may be filled. Here, the range of +0.5 micrometers will be set up for permeability, contrast, etc. separating from desired spec. to -0.5 micrometers and Hmax to Hmin, if the variation in cell ** exceeds **0.5 micrometers. For example, permeability changes ten percent or more by -0.5 micrometers, and contrast becomes a half grade by +0.5 micrometers.
[0025] Furthermore, highest height Hmax from the substrate front face in the reflecting layer front face of the shape of height h from the substrate front face in the insulating-layer front face in a non-display field and toothing in a viewing area and the minimum lowness Hmin are Hmin-0.5 <=h<=Hmax +0.5. (unit : micrometer)
By forming the insulating layer of a non-display field, the difference of the interaction of the front face and spacer which support a spacer is made still smaller in a viewing area and a non-display field, and it becomes possible to realize uniform cell ** over the whole panel so that ****** may be filled.
[0026] Furthermore, by preparing the shape of toothing in the insulating-layer front face in a non-display field, the difference of the interaction of the front face and spacer which support a spacer is made still smaller, and it becomes possible to realize uniform cell ** over the whole panel.

[0027] Furthermore, since the surface state of a viewing area and a non-display field becomes the same and the influence on the spacer in a cell becomes the same by forming in a non-display field the layer insulation layer which has the front face of the shape of toothing of the almost same pattern as a viewing area, a cell gap is uniformly maintainable. Moreover, since change of the shape of surface type by change of the manufacture conditions of a layer insulation layer as well as a viewing area and a non-display field influences, even if it changes manufacture conditions, it can suppress and prevent changing a cell gap. In addition, what is necessary is just to use as the almost same pattern the shape of surface type which applied the thickness of a reflecting layer in the viewing area, and the shape of surface type of a non-display field, in the thickness of the reflecting layer of a viewing area is thick and affecting a cell gap.
[0028] If it is in this invention, it is possible to form a layer insulation layer not only in a viewing area but in a non-display field, and to control a cell gap by the spacer of the same particle size uniformly. The homogeneity of a cell gap can be further raised by still more specifically making the same substantially the distribution (distribution of the thickness from a substrate front face) of the height from the substrate front face (a glass front face or regular flat surface) of the layer insulation layer front face which is a spacer support front face in a viewing area and a non-display field. A cell gap is uniformly controllable if the mode (the area occupied most is the thickness from a latus substrate front face) is the same in a viewing area and a non-display field among the distributions of the thickness from the substrate front face of a layer insulation layer front face. Of course, if the whole distribution of thickness is the same, the homogeneity of a cell gap will improve further.
[0029] Especially the effect of improvement in the display quality by raising the homogeneity of a cell gap is remarkable in a reflective transparency two-ways type liquid crystal display. Especially, the liquid crystal display of the outstanding display quality can be offered [by adjusting the thickness of the layer insulation layer 15 in a reflective transparency two-ways type liquid crystal display] by being in agreement in the optical path length of a reflective field and a transparency field by controlling the liquid crystal layer thickness of a reflective field to drop to 1/2 of the liquid crystal layer thickness of a transparency field.
[0030] Furthermore, while the adhesive property of a sealing compound and both substrates is improved by considering as the composition which does not form a layer insulation layer in a seal field, the reliability of the seal section improves.
[0031] The following terms are used in this application specification. In a reflective transparency two-ways type liquid crystal display, the field which displays the field which displays using the transmitted light using a transparency field and the reflected light is called reflective field, respectively. A transparency field and a reflective field contain the transparency electrode field and reflector field which were formed on the substrate, and the liquid crystal layer pinched by the substrate of a couple, respectively. The transparency electrode field and reflector field on a substrate specify a transparency field and a reflective field, respectively. A transparency electrode field is typically prescribed by the transparent electrode. A reflector field may be prescribed by the combination of a reflector or a transparent electrode, and a reflecting layer.
[0032]
[Embodiments of the Invention] Hereafter, it explains, referring to a drawing about the form of operation of this invention. First, the reflective transparency two-ways type liquid crystal display with which this invention is applied suitably, and its manufacture method are explained.
[0033] Some reflective transparency two-ways type liquid crystal displays 100 by this invention are typically shown in drawing 1 . Drawing 1 (a) is a plan and drawing 1 (b) is the cross section which met the A-A' line of drawing 1 (a).
[0034] A liquid crystal display 100 is a reflective transparency two-ways type liquid crystal display which has reflective field 110R and transparency field 110T in the picture element field 110. As for reflective field 110R and transparency field 110T, each is specified by the reflector field 19 and the transparency electrode field 18 on the active-matrix substrate 20. In this example, the reflector and the transparency electrode field 18 are formed for the reflector field 19 by the transparent electrode, respectively. It connects with TFT (TFT) 21 and a reflector 19 and a transparent electrode 18 function as a picture element electrode.
[0035] The liquid crystal display 100 has the viewing area 38 which consists of two or more picture element fields 110 arranged in the shape of a matrix, and the surrounding non-display field 37 of a viewing area 38. In the periphery section of the non-display field 37, while sticking the active-matrix substrate 20 and the opposite substrate (light-filter substrate) 60, it has the seal field 35 specified in the seal section 50 for enclosing the liquid crystal layer 70 among both the substrates 20 and 60. In addition, a viewing area is a field where a pixel exists, and non-display fields are fields other than a viewing area. There are a field where an insulating layer exists, and a field not existing as non-display field, and the field where an insulating layer exists here is illustrated as a non-display field 37. In addition, although contained to a non-display field, even if a seal field prepares an insulating layer, it is not necessary to prepare it.
[0036] The reflector 19 is formed on the layer insulation layer 15. Surface 15a of the layer insulation layer 15 of a

portion in which the reflector 19 is formed has the shape of toothing. This is for making the reflector of a reflector 19 into the shape of toothing, and realizing the reflection property in which the few good white display of generating of the interference color is possible. moreover . By adjusting the thickness of the layer insulation layer 15, the thickness dR of the liquid crystal layer 70 of reflective field 110R is controllable to become 1/double precision of the thickness dT of the liquid crystal layer 70 of transparency field 110T. This layer insulation layer 15 is formed not only the inside of reflector field 110R in a viewing area 38 but in the non-display field 37.

[0037] The interval cell gap with the substrates 20 and 60 of a couple was held by the spacer 34 in a cell at constant value, and is firmly pasted up by the sealing material which added the spacer 36 in a seal. Usually, in consideration of the thickness of the light-filter layer 33 of the opposite substrate which is not in the seal field 35 etc., a thing larger several micrometers than the spacer 34 in a cell is chosen, and the size of the spacer 36 in a seal is optimized so that the curvature of a glass substrate 11 may not arise in the about 35 seal field viewing area 38.

[0038] According to this invention, affect the cell gap specified by the spacer 34 in a cell. The height hd from the substrate front face of layer insulation layer 15 front face which is not being worn by the height or reflector of reflector 19 front face from a substrate front face in the viewing area 38 which is a spacer back face, The height hp from the substrate front face of layer insulation layer 15 front face in the non-display field 37 is substantially the same, and the poor display by the variation in a cell gap does not occur.

[0039] The height hd from the substrate front face of layer insulation layer 15 front face which is not being worn by the height or reflector of reflector 19 front face from a substrate front face in a viewing area 38, the height hp of the layer insulation layer 15 in the non-display field 37 is substantially the same -- **** -- When the cell gap of a viewing area 38 and the non-display field 37 is controlled by the spacer of the same particle size, it says not producing change of a cell gap which produces a poor display in the border area of a viewing area 38 and the non-display field 37. That is, the conditions of the height (the range of height and/or distribution of height) from the substrate front face of layer insulation layer 15 front face required in order to realize the state where the interval of the substrates 20 and 60 of a couple is uniformly controlled by the spacer 34 of the same particle size prepared on the layer insulation layer 15 on the reflector 19 in a viewing area 38 or the layer insulation layer 15 and in the non-display field 37 are said. How to realize these conditions and conditions concretely is explained in the following operation forms 1-3.

[0040] Below, it is a book.

[0041] Drawing 2 is the plan having shown the active-matrix substrate 20 used for a reflective transparency two-ways type liquid crystal display, and drawing 3 (a), drawing 3 (b), drawing 4 (a), drawing 4 (b), drawing 5 (a), and drawing 5 (b) are drawings showing the manufacturing process of the active-matrix substrate 20, and are the cross section which met the B-B' line of drawing 2 .

[0042] As shown in drawing 2 and drawing 5 (b), on the glass substrate 11 which is an insulating substrate, two or more gate bus lines 22 as the scanning line and the source bus line 24 as a signal line cross by turns, and the these reflective transparency two-ways type active-matrix substrate 20 is formed. In the field of the shape of a rectangle surrounded by each gate bus line 22 and each source bus line 24, the transparent electrode 18 which consists of a high material of light-transmission efficiency is arranged independently, and the reflector 19 which consists of a high material of light reflex efficiency, and it form the pixel electrode by these reflectors 19 and the transparent electrode 18.

[0043] The gate electrode 23 installed in the corner in the field where each of this pixel electrode has been arranged toward the picture element electrode from the gate bus line 22 has branched, and TFT (TFT) 21 is formed in a part for the point of this gate electrode 23 as a switching element. The above-mentioned gate electrode 23 constitutes a part of TFT21.

[0044] TFT21 is arranged above the above-mentioned gate electrode 23 formed on the glass substrate 11, as shown in drawing 5 (b). The gate electrode 23 is covered by gate insulator layer 11a, and on gate insulator layer 11a, the laminating of the semiconductor layer 27 is carried out so that the upper part of the gate electrode 23 may be covered. The both ends on this semiconductor layer 27 are covered, and the contact layers 28 and 28 of a couple are formed.

[0045] It connects with the source electrode 25 electrically, and the source bus line 24 is superimposed on the point of the source electrode 25 formed on the contact layer 28 in the state of an insulation on the gate electrode 23, and constitutes a part of each TFT21. On the gate electrode 23, in the source electrode 25, an interval is vacated, and it superimposes in the state of an insulation in the gate electrode 23, and the drain electrode 26 of TFT21 is formed on the contact layer 28. This drain electrode 26 is electrically connected to the pixel electrode through ground electrode 31a.

[0046] At this time, ground electrode 31a and the gate bus line 22 of the next step form auxiliary capacity by considering as the structure where it laps through gate insulator layer 11a. Moreover, it becomes possible to make influence of a process uniform by [in which the concavo-convex section which mentions this ground electrode 31a later exists] forming in all fields mostly.

[0047] Under the reflector 19 which consists of a high material of the light reflex efficiency mentioned above on the other hand, heights 14a and heights 14b with low height with the high height formed at random on the glass substrate 11, and the macromolecule resin film 15 as a layer insulation layer formed on these heights 14a and 14b exist.
[0048] The upper front face of this macromolecule resin film 15 is continuously wavelike by existence of the heights 14a and 14b which carried out patterning of the photosensitive macromolecule using photolithography technology, and made the angle round with heat treatment. the macromolecule resin film 15 -- not only the lower part of a reflector 19 but the glass substrate 11 -- it forms over the whole region mostly -- having -- **** -- the form of this operation as a material -- Tokyo -- adaptation -- shrine 800 [OFPR-] are used
[0049] It exists on the heights 14a and 14b mentioned above, and the reflector 19 mentioned above is formed on macromolecule resin film 15 wavelike portion which an upper front face follows, light reflex efficiency is high, for example, this reflector 19 is formed of aluminum. In addition, the reflector 19 is electrically connected with the drain electrode 26 through the contact hole 29.
[0050] Moreover, in the reflective transparency two-ways type liquid crystal display of this invention, the transparent electrode 18 is formed independently [a reflector 19], and this transparent electrode 18 is formed by a high material of light-transmission efficiency, for example, ITO etc., (Indium Tin Oxide).
[0051] Next, the formation method of the reflector 19 of the these reflective transparency two-ways type active-matrix substrate 20 and a transparent electrode 18 is explained, referring to drawing 3 (a) and (b), drawing 4 (a) and (b), drawing 5 (a), and (b).
[0052] First, as shown in drawing 3 (a), on the glass substrate 11, two or more gate bus lines 22 (refer to drawing 2) which consist of Cr, Ta, etc., and the gate electrode 23 which branched from this gate bus line 22 are formed.
[0053] These gates bus line 22 and the gate electrode 23 are covered, gate insulator layer 11a which consists of SiNx, SiOx, etc. is formed the whole surface on a glass substrate 11, and the semiconductor layer 27 which consists of amorphous silicon (a-Si), polycrystal silicon, CdSe, etc. is formed on upper gate insulator layer 11a of the gate electrode 23. The contact layers 28 and 28 which consist of amorphous silicon (a-Si) etc. are formed in the both ends of this semiconductor layer 27.
[0054] On the one side of these contact layers 28 and 28, superposition formation of the source electrode 25 which consists of Ti, Mo, aluminum, etc. is carried out, and superposition formation of the drain electrode 26 which consists of Ti, Mo, aluminum, etc. is carried out like the source electrode 25 on the other side.
[0055] In addition, with the gestalt of this operation, the thing with a thickness of 1.1mm whose tradename by Corning, Inc. is 7059 was used as a glass substrate 11, for example.
[0056] Next, as shown in drawing 3 (b), the metal layer 31 which constitutes the source bus line 24 was formed by the spatter, patterning of this metal layer 31 was carried out, and ground electrode 31a was formed simultaneously with the source bus line 24.
[0057] Then, as shown in drawing 4 (a), patterning of the ITO layer 30 which constitutes the source bus line 24 was formed and carried out by the spatter.
[0058] In this operation gestalt, the layer which constitutes the source bus line 24 was made into the two-layer structure of the metal layer 31 and the ITO layer 30. Though a part of metal layer 31 which constitutes the source bus line 24 temporarily has a membranous defect, since the ITO layer 30 connects electrically, there is an advantage that an open circuit of the source bus line 24 can be lessened in this structure.
[0059] While carrying out patterning of the above-mentioned ITO layer 30 and forming the upper layer of the source bus line 24, the transparent electrode 18 which constitutes a pixel electrode was formed. Being able to make a transparent electrode 18 simultaneously at the time of formation of the source bus line 24, and causing the increase in a number of layers by doing in this way, is lost.
[0060] Next, as shown in drawing 4 (b), the cross section which consists of a resist film 12 of an optical photopolymer and by which the angle chute was carried out forms the heights 14a and 14b of an approximate circle configuration in the bottom of the field where patterning of the reflector 19 is carried out. Although it is more desirable not to form Heights 14a and 14b on a transparent electrode 18 at this time in order to impress voltage to a liquid crystal layer efficiently, even if it forms the transparent-electrode 18 convex section, it will not have big influence optically.
[0061] Here, the formation process of the heights 14a and 14b formed in this reflector field is explained, referring to drawing 6 (a) - drawing 6 (d).
[0062] First, as shown in drawing 6 (a), the resist film 12 which consists of an optical photopolymer is formed with a spin coat method on a glass substrate 11 (in practice, as shown in drawing 4 (b), on the glass substrate 11, the metal layer 31 and ground electrode 31a are already formed.). In addition, with 3000rpm from 500rpm, and this operation form, the spin coat of the optical photopolymer of OFPR-800 which are the material same as a resist film 12 as the macromolecule resin film 15 mentioned later was preferably carried out for 30 seconds by 1500rpm, and thickness of

the resist film 12 was set to 2.5 micrometers.
[0063] Next, the glass substrate 11 with which this resist film 12 was formed is prebaked for 30 minutes at 90 degrees C.
[0064] then, the circular pattern of 13c2 kinds of boards as shown in drawing 7 -- the photo mask 13 in which Holes 13a and 13b are formed is used, this photo mask 13 is arranged above the resist film 12, as shown in drawing 6 (b), and as the arrow of drawing shows from the upper part of this photo mask 13, it exposes
[0065] in addition, the pattern with which the photo mask 13 in this operation form carried out the round shape with a diameter of 5 micrometers -- a hole -- the pattern which set the round shape with a diameter of 3 micrometers to 13a -- a hole -- the pattern which 13b is arranged at random and approaches mutually -- at least 2 micrometers or more of intervals of a hole are isolated However, if isolated not much too much, the upper front face of the macromolecule resin film 15 cannot become continuously wavelike easily.
[0066] next, Tokyo -- negatives are developed using the developer of 2.38% of concentration which consists of NMD-3 made from adaptation thereby -- drawing 6 -- (-- c --) -- being shown -- as -- a glass substrate -- 11 -- one side -- a reflector -- a field -- height -- differing -- being detailed -- heights -- 14 -- a -- ' -- 14 -- b -- ' -- a large number -- forming -- having . As for these heights 14a' and 14b', the upper limb is square. this operation form -- a pattern with a diameter of 5 micrometers -- a hole -- the pattern which with a height of 2.48 micrometers heights 14a is formed of 13a, and is the diameter of 3 micrometers -- a hole -- with a height of 1.64 micrometers heights 14b was formed of 13b
[0067] the height of these heights 14a' and 14b' -- a pattern -- making it change with the size of Holes 13a and 13b, the exposure time, and developing times -- possible -- a pattern -- it is not limited to the above-mentioned size as a size of Holes 13a and 13b moreover, a pattern -- one kind is sufficient as the diameter of a hole
[0068] Next, as shown in drawing 6 (d), it heat-treats by heating the glass substrate 11 in which heights 14a' and 14b' were formed, at 200 degrees C for 1 hour. this -- drawing 6 -- (-- c --) -- having been shown -- as -- a upper limit -- the section -- a corner -- having -- developing negatives -- having had -- as -- heights -- 14 -- a -- ' -- 14 -- b -- ' -- softening (heat whom) -- carrying out -- making -- the above -- a corner -- round -- having become -- that is, -- an angle -- a chute -- carrying out -- having had -- a cross section -- an approximate circle -- a configuration -- heights -- 14 -- a -- 14
[0069] The heights 14a and 14b shown in drawing 4 (b) according to a process which was mentioned above are formed.
[0070] Next, as shown in drawing 5 (a), the spin coat of the macromolecule resin was carried out on the glass substrate 11, patterning was carried out and the macromolecule resin film 15 was formed. OFPR-800 mentioned above are used as a macromolecule resin film, and a spin coat is preferably carried out by 1000rpm - 3000rpm. With this operation gestalt, the spin coat was carried out by 2000rpm.
[0071] By this, even if the portion on the glass substrate 11 with which Heights 14a and 14b are not formed is flat, the macromolecule resin film 15 which carried out the sinuate which an upper front face follows will be formed.
[0072] Next, as shown in drawing 5 (b), the reflector 19 which consists of aluminum was formed in the predetermined part on the macromolecule resin film 15 mentioned above for example, using the sputtering method. As a material suitable for using it for a reflector 19, Ta, nickel, Cr, Ag, etc. for example, with high light reflex efficiency can be mentioned other than aluminum or aluminum alloy, and about 0.01-1.0 micrometers is suitable as thickness of a reflector 19.
[0073] Thus, the polarizing plate which is not illustrated at the rear face of the active-matrix substrate 20 in this produced operation gestalt is arranged in lamination and a pan, and a back light is arranged in the outside of a polarizing plate.
[0074] Although electric corrosion will occur if aluminum film is formed here where the macromolecule resin film 15 on a transparent electrode 18 is removed, this can be prevented by leaving the macromolecule resin film 15 on a transparent electrode 18.
[0075] By removing collectively the macromolecule resin film 15 on the terminal electrode for connecting the driver formed in the circumference edge of the active-matrix substrate 20, as soon as ashing processing removes the macromolecule resin film 15 on a transparent electrode 18, the increase in efficiency of a process can be attained and it becomes possible to impress voltage to a liquid crystal layer efficiently.
[0076] In addition, in the formation process of the concavo-convex section which does not use the macromolecule resin film 15, it becomes possible to prevent electric corrosion by passing through the process which forms layers, such as Mo, between the reflectors 19 which consist of a transparent electrode 18 which consists of ITO, and aluminum.
[0077] Thus, since the macromolecule resin film 15 makes a it top as it is continuously wavelike and is formed as mentioned above, the reflector 19 which consists of a high material of the formed light reflex efficiency becomes continuously wavelike [an upper front face] similarly.
[0078] In addition, a bright paper white display is attained by optimizing the number of the heights of a viewing area,

or a crevice, if there is too little irregularity of a viewing area, the regular reflection of a flat part increases and the dispersion property in which a paper white is possible cannot be realized. Moreover, if many [too], concavo-convex random arrangement will become difficult and interference of the reflected light will occur. In the present production conditions, 15000 heights [5300 / /] /are formed by the density of 2 mm mm at a reflected type liquid crystal display with the density of 2, and a transparency reflective two-ways type liquid crystal display. Moreover, about a non-display field, when the density of heights or a crevice becomes small, in being heights formation, the area to expose increases, thickness's of layer insulation film existence frequency shifts to the direction of the minimum thickness, the area which it exposes in being crevice formation decreases, and thickness's of layer insulation film existence frequency shifts to the direction of the highest thickness. Therefore, since the difference of the interaction of the front face and spacer which support a spacer can be made still smaller in a viewing area and a non-display field by making the number of the irregularity of a non-display field approximate with a viewing area, it is desirable.

[0079] In this operation gestalt, although the transparent electrode 18 is formed simultaneously with formation of the source bus line 24, when the source bus line 24 is not the two-layer structure of the metal layer 31 and the ITO layer 30 but the monolayer of the metal layer 31, formation of a transparent electrode 18 and formation of the source bus line 24 may be separate.

[0080] The active-matrix substrate 20 formed by the above-mentioned method and the opposite substrate 60 separately manufactured by the well-known method are stuck, and a liquid crystal display 100 is manufactured. The opposite substrate 60 has the black matrix 32 for having a counterelectrode (un-illustrating) on the whole surface mostly, and shading the gap of a picture element field, and a non-display field of the viewing area on a glass substrate 11. Moreover, you may form the light-filter layer 33 if needed. In addition, even if it forms a counterelectrode (un-illustrating) in the liquid crystal layer 70 side of the light-filter layer 33, you may form it in a substrate 11 side. Moreover, an orientation film (un-illustrating) is formed in the liquid crystal layer 70 side front face of both the substrates 20 and 60 if needed, and orientation processing is performed.

[0081] The cell gap with both the substrates 20 and 60 was held at constant value by the spacer 34 in a cell sprinkled on one [at least] substrate (20 or 60), and is firmly pasted up by the sealing compound which added the spacer 36 in a seal. In addition, the seal section 50 formed of a sealing compound has opening for pouring in liquid crystal material, and at least one so-called inlet (un-illustrating). After an inlet pours in liquid crystal material, it obturates it using a hardenability resin.

[0082] Usually, in consideration of the thickness of the light-filter layer 33 of the opposite substrate 60 which does not exist in the seal field 35 etc., a thing larger several micrometers than the spacer 34 in a cell is chosen, and the size of the spacer 36 in a seal is optimized so that the curvature of a glass substrate 11 may not arise in the about 35 seal field viewing area 38. In order to prevent the warp of a glass substrate effectively by this optimization, it is necessary to have the relation with the fixed height hd from the substrate front face of layer insulation layer 15 front face which is not being worn by the height or reflector from a substrate front face of reflector 19 front face which is the thickness hp from the substrate front face of layer insulation layer 15 front face in the non-display field 37 (the seal field 35 is included), and a spacer back face in a viewing area 38.

[0083] As a spacer 34 in this cell, with the gestalt of this operation, the micro pearl series of the Sekisui fine-chemicals company which is a spherical spacer was used, and the glass fiber by Nippon Electric Glass Co., Ltd. which is a pillar-like spacer was used as a spacer 36 in a seal, for example.

[0084] As a concrete process, apply an orientation film (un-illustrating) to the active-matrix substrate 20 and the opposite substrate 60 by the thickness of about 100nm, and rubbing processing is performed. The spacer 34 in a cell on one [at least] substrate 100 (piece/mm2) grade, After sprinkling uniformly, applying the heat-hardened type epoxy system seal resin material which added the spacer 34 in a seal about 1 - 10% of heavy quantitative ratios on one [at least] substrate with the dispenser applying method or screen printing and sticking both the substrates 20 and 60, Heat hardening of the substrates 20 and 60 of the stuck couple was carried out under the high-pressure force by the press machine. Then, it divided by having met the fragmentation line 41 (drawing 10), liquid crystal material was poured in and obturated by the vacuum pouring-in method, and the liquid crystal display cell was obtained.

[0085] In the following operation gestalten 1-3, the composition and its manufacture method of a layer insulation layer for obtaining a uniform cell gap are explained concretely.

[0086] (Operation gestalt 1) The reflective transparency two-ways type liquid crystal display 200 by the operation gestalt 1 is explained, referring to drawing 8 A and drawing 8 B. Drawing 8 A shows the plan of the picture element field section of the active-matrix substrate 80 of a liquid crystal display 200, and drawing 8 B shows the fragmentary sectional view of a liquid crystal display 200. In addition, in the following drawings, the same reference mark is given to the component explained previously and the component which has the same structure and the same function substantially, and detailed explanation is omitted. In the liquid crystal display 200 of this operation gestalt 1, the front

face of the layer insulation layer 85 on TFT21, the gate bus line 22, and the source bus line 24 is also made into the shape of toothing.

[0087] Since the layer insulation layer 85 on TFT21, the gate bus line 22, and the source bus line 24 is influenced of the level difference of a ground, the height from a substrate front face becomes high rather than the layer insulation layer 85 of other fields. Therefore, by making the front face of the layer insulation layer 85 on TFT21, the gate bus line 22, and the source bus line 24 into the shape of toothing, it can be made the almost same height as the front face of the layer insulation layer 85 of other fields, and a uniform cell gap can be obtained. Furthermore, since the reflector field which has a toothing-like front face can be formed on TFT21, the gate bus line 22, and the source bus line 24, the ambient light of the various degrees of incident angle can be used still more effectively as a display light.

[0088] In addition, although not shown in drawing 8 A, it has the same composition in the non-display field 37 of the active-matrix substrate 80 shaded by the black matrix 32 substantially with the picture element field of a viewing area 38, and the dummy picture element (un-illustrating) which does not contribute to a display may be formed in it. Moreover, when the active element and layer insulation layer which do not contribute to image display when the dummy picture element is not formed, and the bus line (gate wiring, source wiring) and the layer insulation layer are formed for example, are formed, only the layer insulation layer may be formed.

[0089] With this operation form, the photo mask which has the same shading pattern as a viewing area 38 in the case of which is used, referring to drawing 6 , as explained previously, heights are formed, and the layer insulation layer 85 which has the shape of toothing on a front face is formed also in the non-display field 37. The influence of the wiring under the layer insulation layer 85 of the non-display field 37 etc. is not necessarily the same as a viewing area 38. About this layer insulation layer 85, the distribution (distribution of thickness) of the height from a substrate front face was measured with the cross-section SEM observational method or the interference microscope. The histogram with which the thickness (height on the front face of a reflector from a substrate front face) from a substrate front face is expressed with about 0.2-micrometer serration for the result to a horizontal axis as shown in drawing 9 , and the number of abundance is expressed to a vertical axis was created. The thickness distributions from a substrate front face differ somewhat in a viewing area 38 and the non-display field 37 so that this drawing 9 may show. However, the shape of toothing is formed in the front face of the layer insulation layer 85 of the non-display field 37, and by making it the same as the shape of surface type of the layer insulation layer 85 of a viewing area 38, even if it sprinkles the same spacer 34 in a cell all over the panel of a liquid crystal display 200, a uniform cell gap can be obtained. In addition, since thickness of a reflector 19 was set to 0.3 micrometers, although the layer insulation layer 85 was formed by the almost same pattern in the viewing area and the non-display field, when the thickness of a reflector 19 affects it, the shape of surface type of a non-display field is made to be the same as that of the configuration on the front face of a reflector here at the shape of surface type of a viewing area 38 including the thickness of a reflector 19.

[0090] In the average thickness (average of the thickness in **** of a crevice, and the thickness in the peak of heights) of the toothing-like section from a substrate front face (glass front face), with this operation form, the diameter of about 2 micrometers and the spacer in a cell set the diameter of about 3 micrometers and the spacer in a seal to about 5.2 micrometers.

[0091] Furthermore, there are also the following advantages in this operation form.

[0092] the conditions at the time of the shape of toothing and thickness of the layer insulation layer 85 forming heights (14a and 14b of drawing 6) using a photopolymer, and the application conditions and exposure conditions of a resin -- it is especially greatly dependent on heat treatment conditions (heat whom conditions), and dispersion in the shape of about several% of toothing and thickness occurs between production lot Since the shape of toothing of a viewing area 38 and the shape of toothing of the seal field 35 of thickness and the non-display field 37 vary similarly, since it is kept constant even if manufacture conditions change somewhat, the relation of the optimal size of the spacer 36 in a seal to the size of the spacer 34 in a cell can prevent generating with a poor cell gap by the gap from the optimum value of the size of the spacer 34 in a cell, and the spacer 36 in a seal.

[0093] Moreover, as shown in drawing 10 , when manufacturing the liquid crystal panel 210 of a liquid crystal display using the many beveling method from the mother glass substrate 111, the dummy seal field 40 may be formed not only for the seal field 35 of a liquid crystal panel 210 but for reinforcement etc. In this case, a layer insulation layer is formed also in the dummy seal field 40, and the shape of toothing is formed in the front face like the layer insulation layer of a liquid crystal display. Even if this uses the spacer 36 in a seal of the same size in the seal field 35 and the dummy seal field 40 of a cell, generating of the curvature of the mother glass substrate 111 by the difference in the cell gap in the seal field 35 and the dummy seal field 40 of a liquid crystal panel can be suppressed and prevented. Therefore, the homogeneity of the cell gap of the liquid crystal display obtained can be raised further.

[0094] Furthermore, when characterized by forming irregularity in the layer insulation layer which exists in the non-display field 37, the spacer 34 in a cell may fall in a concavo-convex crevice. Under such a situation, a cell gap smaller

than the particle size of a spacer is uniformly realizable. Since it follows on generally making particle size of a spacer small and the manufacture yield decreases greatly, the price of a spacer rises. According to this invention, it becomes possible to obtain the uniform cell gap of 2 micrometers, for example by use of a plastics spacer with a diameter of 3 micrometers. In addition, in a drawing, as shown, for example in drawing 15 (a), a crevice equivalent to the diameter of a spacer may exist, or although the interval of the concavo-convex section is shown smaller than the diameter of a spacer for conspicuousness, as shown in drawing 15 (b), a bigger crevice than the diameter of a spacer may exist.
[0095] In addition, although the shape of same toothing as a viewing area 38 was prepared in the front face of the layer insulation layer 85 of the non-display field 37 with this operation form, as shown, for example in drawing 16 (a), you may prepare a level difference in the layer insulation layer of a non-display field. In this case, highest height Hmax (for example, 3 micrometers) from the substrate front face in the reflecting layer front face of the shape of toothing in the mode (height from the substrate front face where the area occupied most is large) hmode of the height from the substrate front face in the layer insulation layer front face of a non-display field, and a viewing area, and the minimum lowness Hmin (for example, 2 micrometers) are Hmin-0.5 <=hmode<=Hmax +0.5. (unit : micrometer)
It is possible by forming the insulating layer of a non-display field to carry out the display unevenness resulting from cell thick unevenness into tolerance so that ****** may be filled.
[0096] Furthermore, highest height Hmax from the substrate front face in the reflecting layer front face of the shape of height h from drawing 16 (b-1) and (b-2) a substrate front face [in / the insulating-layer front face in a non-display field / so that it may be shown], and toothing in a viewing area, and the minimum lowness Hmin are Hmin-0.5 <=h<=Hmax +0.5. (unit : micrometer)
By forming the insulating layer of a non-display field, the difference of the interaction of the front face and spacer which support a spacer is made still smaller than the case of drawing 16 (a) in a viewing area and a non-display field, and it becomes possible to realize uniform cell ** over the whole panel so that ****** may be filled. In this case, even if the front face of the insulating layer in a non-display field is toothing-like, it may be flat. .
[0097] furthermore, the difference of the interaction of the front face and spacer which support a spacer by preparing the shape of toothing in the insulating-layer front face in a non-display field even if it is a different configuration from the insulating layer in a viewing area, as shown in drawing 16 (c) -- drawing 16 (a) -- and (b-1) (b-2) a case -- a nearby monostromatic -- it is made small and it becomes possible to realize uniform cell ** over the whole panel
[0098] (Operation form 2) The reflective transparency two-ways type liquid crystal display 300 by the operation form 2 is explained, referring to drawing 11 A and 11B. Drawing 11 A shows the plan of the picture element field section of the active-matrix substrate 90 of a liquid crystal display 300, and drawing 11 B shows the fragmentary sectional view of a liquid crystal display 300.
[0099] With the operation form 2, while unlike the operation form 1 not forming heights (refer to drawing 6) on TFT21 of a viewing area 38, the source bus line 24, and the gate bus line 22, and not forming the shape of toothing in the front face on the layer insulation layer 95 on TFT21, the source bus line 24, and the gate bus line 22 but having the flat front face, the front face of the layer insulation layer 95 of the non-display field 37 is also a flat front face without the shape of toothing. That is, the layer insulation layer 95 formed in the reflective field has the toothing-like front face.
[0100] The result which measured the thickness of the layer insulation layer 95 of this active-matrix substrate 90 like the operation gestalt 1 is shown in drawing 12 . Although surface concavo-convex states differ in the viewing area 38 and the non-display field 37 so that the histogram of drawing 12 may show, also in which field, the point of the field (M) where a distribution is the highest which is a flat portion corresponds. In addition, in drawing 11 A, portions other than the reflective field of bus-line superiors are the flat parts which have the thickness of fixed thickness, and have become the field which accounts for a remarkable rate and where a distribution is the highest. And since the flat part of a viewing area is the unexposed section as shown in drawing 11 B, compared with the concavo-convex section, thickness becomes thick.
[0101] For this reason, the cell gap of a viewing area 38 is controlled by the spacer 34 on the flat part (for example, formed as mentioned above on TFT21, the source bus line 24, and the gate bus line 22) of the layer insulation layer 95 in a picture element field, the cell gap of the non-display field 37 will also be controlled by the spacer 34 on the flat front face of the layer insulation layer 95, and a uniform cell gap without variation is obtained.
[0102] In the average thickness of the toothing-like section from about 4 micrometers and a substrate front face, with this operation gestalt, the diameter of about 2 micrometers and the spacer in a cell set [the thickness from the substrate front face (glass front face) of a layer insulation layer] the diameter of about 5.2 micrometers and the spacer in a seal to about 5.2 micrometers.
[0103] in addition, the thickness of the layer insulation layer 95 which has a toothing-like front face in the example shown in drawing 11 B -- heat -- although it is smaller than the thickness of the layer insulation layer 95 which has a

flat front face by whom, the thickness from the substrate front face of a flat part and the concavo-convex section or the height from the substrate front face on the front face of a reflector on it can be made the same like drawing 1 by adjusting manufacture conditions In case the resist (positive type) layer 12 (refer to drawing 6) used as the ground of the layer insulation layer 95 of having a toothing-like front face is exposed The thickness of a ground layer is reduced by carrying out suitable amount exposure of the ground layer of the flat part which was not exposed conventionally. Thickness from the substrate front face of the flat part of the layer insulation layer 95 formed on it can also be made the same as the thickness from the substrate front face of the toothing-like section, or the height from the substrate front face on the front face of a reflector on it. Moreover, when a negative resist is used, by adjusting light exposure suitably, ground layer thickness can be adjusted and thickness from the substrate front face of the flat part of the layer insulation layer 95 can also be made the same as the thickness from the substrate front face on the toothing-like section or the front face of a reflector on it. Thus, since the distribution of the thickness from the substrate front face of the front face which supports a spacer in a viewing area 38 and the non-display field 37 can be close brought further by adjusting thickness, a still more uniform cell gap can be obtained.

[0104] In addition, in this operation form, although thickness of the layer insulation layer 95 was made the same in the flat part of a viewing area 38, and the flat part of the non-display field 37, you may give the range of thickness, such as **0.5 etc. micrometers, also in this case.

[0105] (Operation gestalt 3) The reflective transparency two-ways type liquid crystal display 400 by the operation gestalt 3 is explained, referring to drawing 13 . Drawing 13 shows the fragmentary sectional view of a liquid crystal display 400. A liquid crystal display 400 differs from the operation gestalt 1 and an example 2 in the point which does not form the layer insulation layer 95 in the seal field 35 of the active-matrix substrate 98 specified in the seal section 55. When producing the liquid crystal panel of this liquid crystal display 400 using the many beveling method shown in drawing 10 , the layer insulation layer 95 is not formed in the dummy seal field 40 like the seal field 35.

[0106] In addition, the composition of layer insulation layers 95 other than seal field 35 may form the shape of toothing in the whole surface like the operation form 1, and may form a flat front face in the part and non-display field of a viewing area 38 like the operation form 2. Moreover, as shown in drawing 13 , a flat part may be formed in a viewing area 38 in part, and the shape of toothing may be formed in the front face of other fields including the non-display field 37.

[0107] In the average thickness of the toothing-like section from about 2 micrometers and a substrate front face, with this operation form, the diameter of about 1.5 micrometers and the spacer in a cell set [the thickness of the flat part of the layer insulation layer from a substrate front face] the diameter of about 3 micrometers and the spacer in a seal to about 7.0 micrometers.

[0108] When not forming the layer insulation layer 95 in the seal field 35, the larger thing by layer insulation layer thickness than the case of the operation forms 1 and 2 will be used for the size of the spacer 36 in a seal. It becomes possible to make comparatively small change of the thickness of lamination and the sealing compound by the compression when carrying out hot press by this from the state which applied or printed the sealing compound to the substrate. Consequently, the problem on which an epoxy resin portion with the low viscosity which is the component of a sealing compound dissociates with a filler portion at the time of hot press, and deteriorates at it, and the poor display which are shown in drawing 14 and which the separated epoxy resin partial 39 grade flows in and causes in a viewing area 38 from an inlet can be prevented. Moreover, the adhesive property of a sealing compound and both the substrates 60 and 98 is improved. Furthermore, since the height of an inlet can be enlarged, the pouring time of liquid crystal material can be shortened sharply. About the panel of 3.5 inches of vertical angles, the pouring time for about 40 minutes became about 20 minutes as compared with the composition of the operation form 2.

[0109] As mentioned above, although the operation form was shown in the reflective transparency two-ways type liquid crystal display, it only differs that transparent-electrode 18 portion does not exist in a picture element field in a reflected type liquid crystal display, and the same effect is realized.

[0110]

[Effect of the Invention] As mentioned above, according to this invention, the cell gap of a viewing area and the cell gap in a non-display field can be made equivalent, and a liquid crystal display without generating with a poor display resulting from the variation in a cell gap can be offered. Especially this invention can offer the reflective transparency two-ways type liquid crystal display which was excellent in display quality.

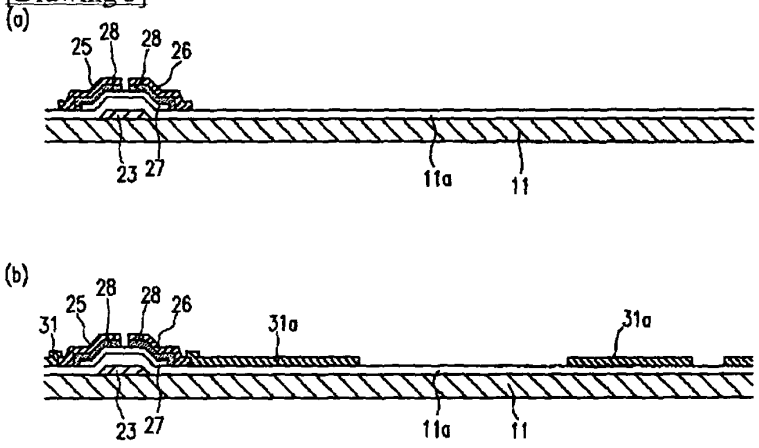
[Translation done.]

* NOTICES *

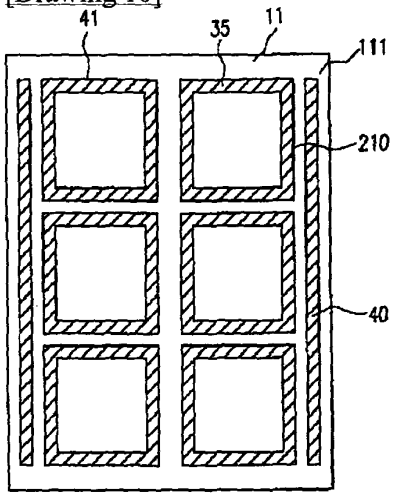
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

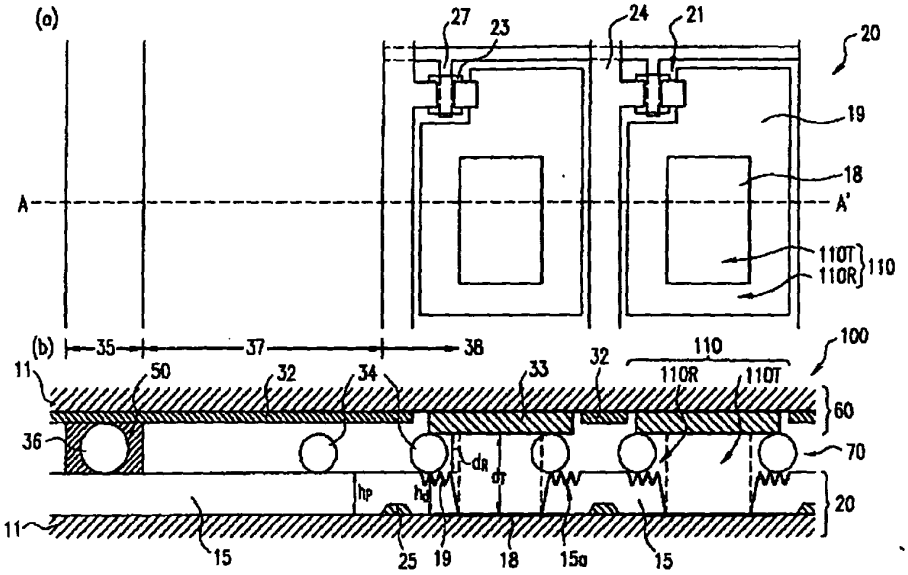
[Drawing 3]



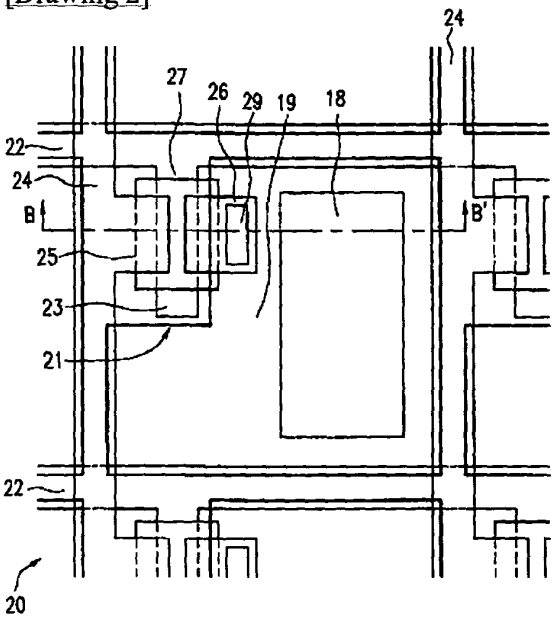
[Drawing 10]



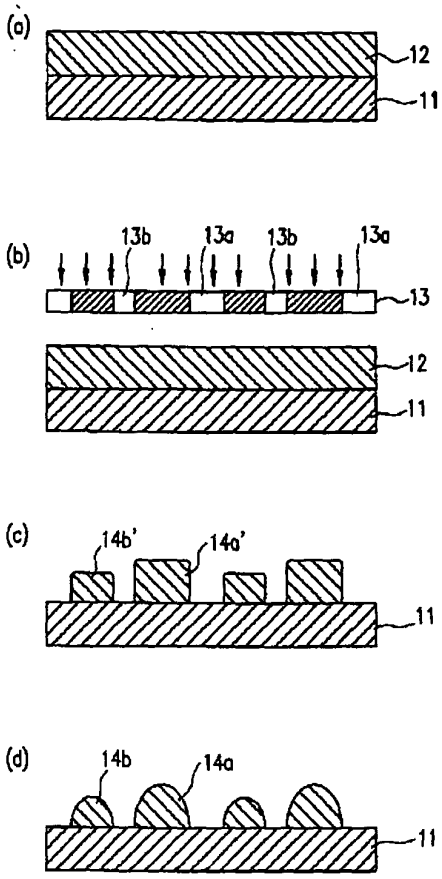
[Drawing 1]



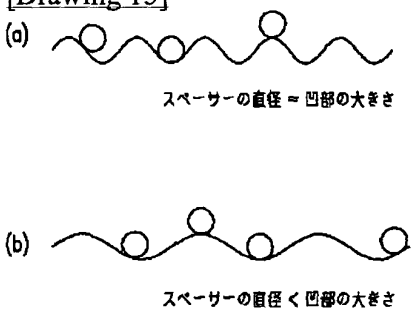
[Drawing 2]



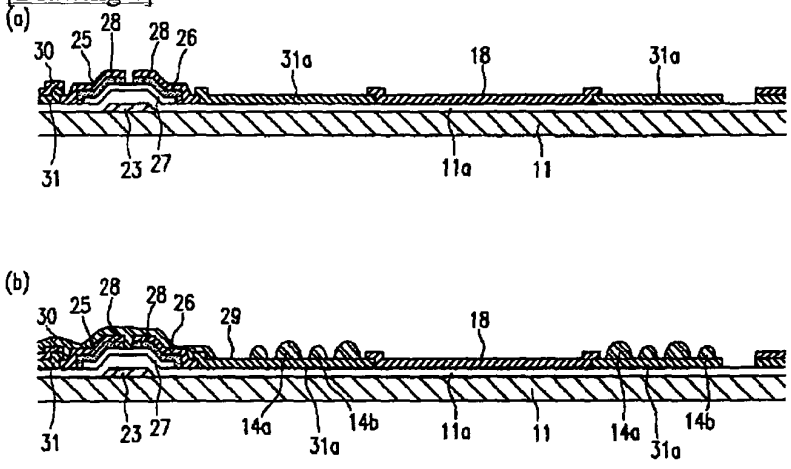
[Drawing 6]



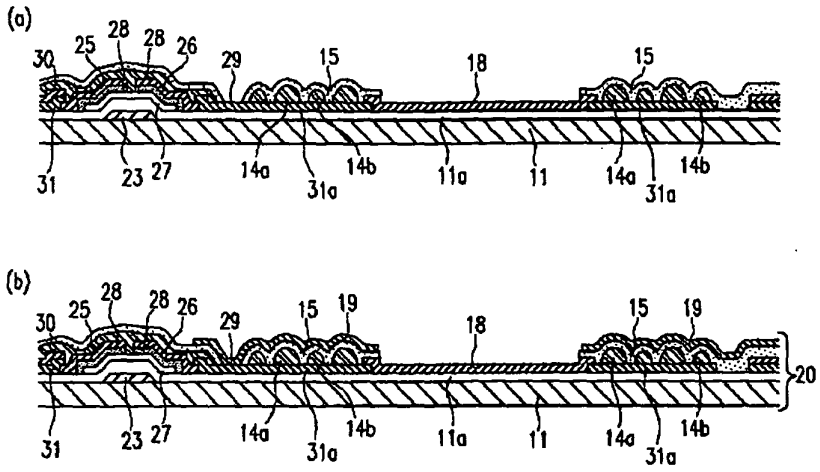
[Drawing 15]



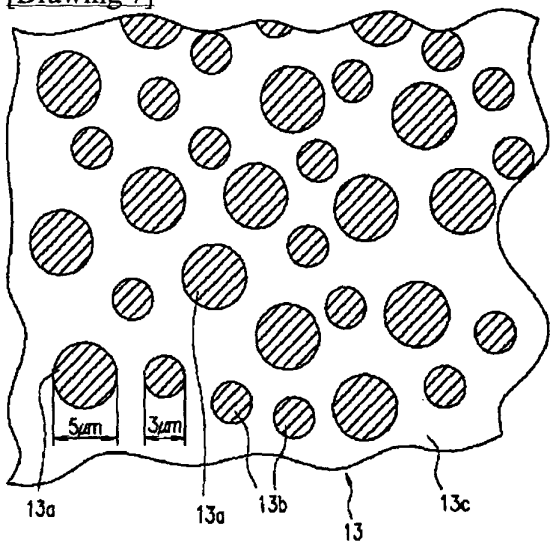
[Drawing 4]



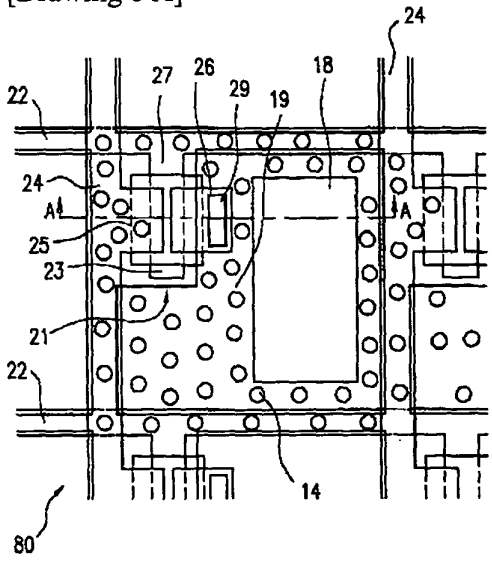
[Drawing 5]



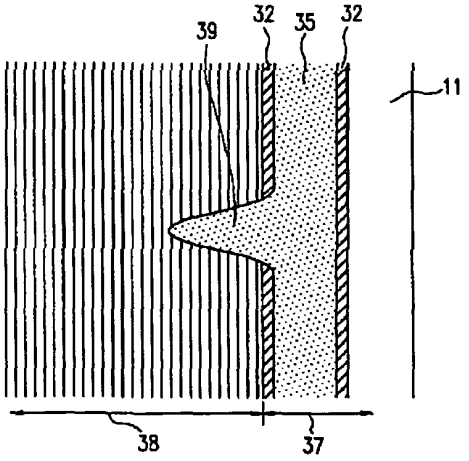
[Drawing 7]



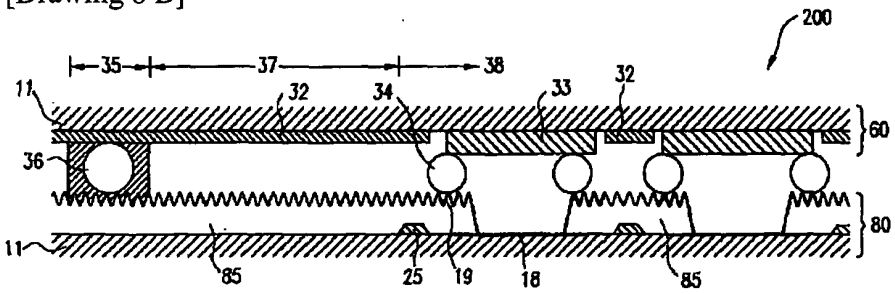
[Drawing 8 A]



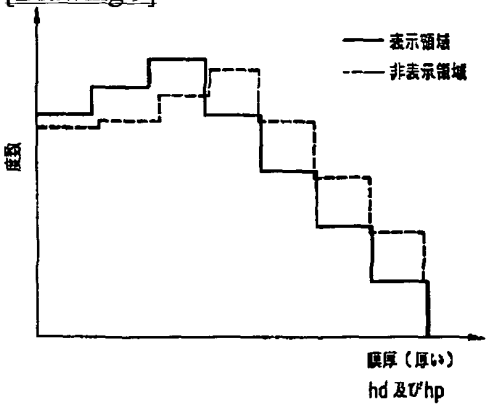
[Drawing 14]



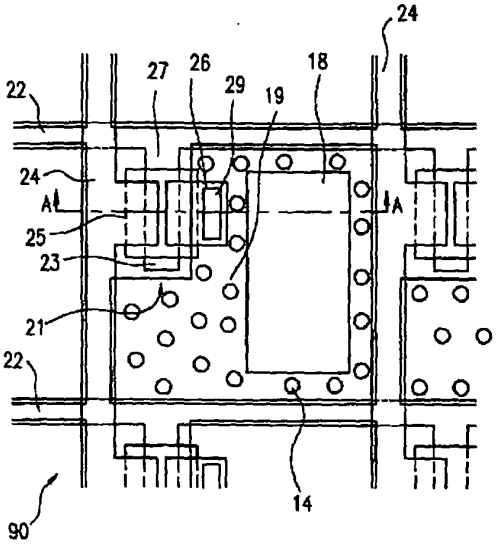
[Drawing 8 B]



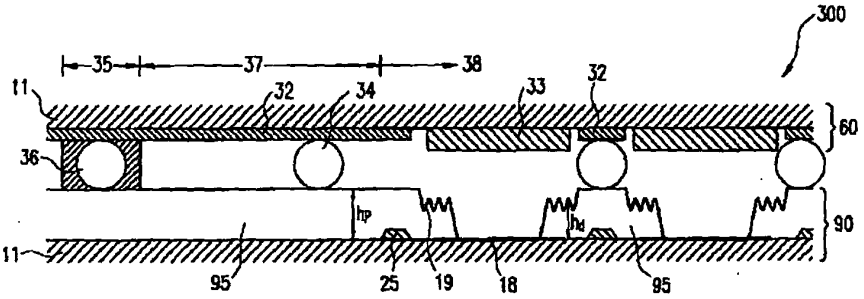
[Drawing 9]



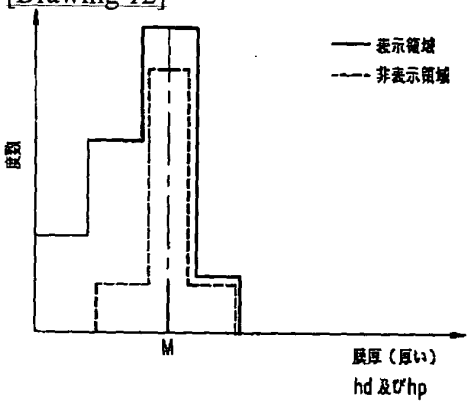
[Drawing 11 A]



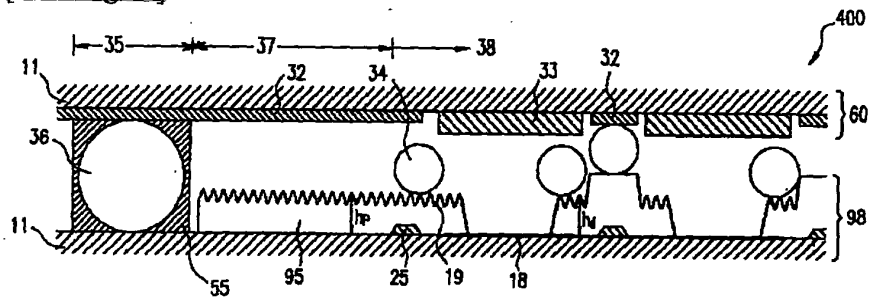
[Drawing 11 B]



[Drawing 12]

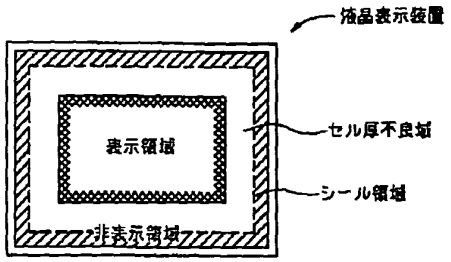


[Drawing 13]

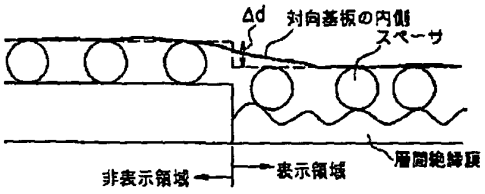


[Drawing 17]

(a)

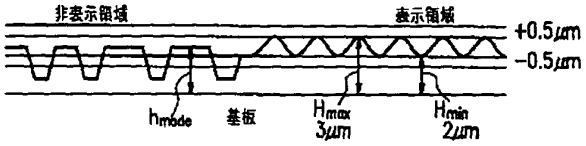


(b)

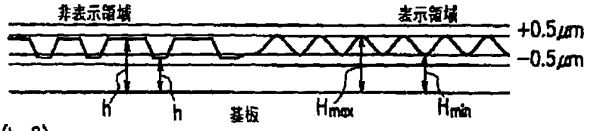


[Drawing 16]

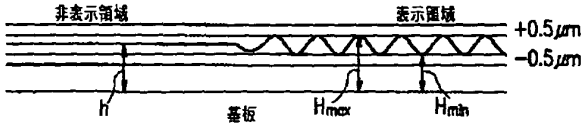
(a)



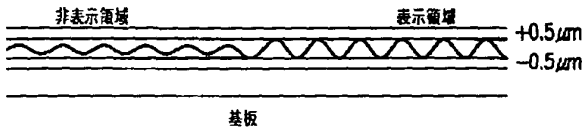
(b-1)



(b-2)



(c)



[Translation done.]